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Research report

Validity of an electronic pressure algometer

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Abstract

Background: Pressure algometry is one of a number of outcome measures that manual therapy practitioners are able to use in both clinical and research settings. The pressure algometer is used to determine the pressure pain threshold of specific muscle and bone locations.
Objective: To determine the validity of a commonly utilised electronic pressure algometer.
Design: A repeated measures design was used.
Setting: Biomechanics Laboratory, Victoria University, Melbourne.
Methods: A total of 300 measurements were collected from the electronic pressure algometer as it was applied perpendicularly to an AMTI force plate. Thirty (30) measurements were taken at five discrete rates of application; 10 kPa/s, 20 kPa/s, 30 kPa/s, 40 kPa/s and 50 kPa/s on two separate occasions. Maximum data were recorded from both the pressure algometer and force plate and analysed using the Intraclass Correlation Coefficient (ICC) statistic and the test for significant equality.
Results: ICC values between the raw pressure algometer maximum values and the converted force plate data were high (ICC 0.905–0.998) for the two separate testing sessions and for both sessions combined (ICC 0.968–0.994). The test of significant equality revealed however that the data could not be considered as significantly the same even when allowing for a 5% or 10% tolerance.
Conclusion: The results indicate that the electronic pressure algometer utilised in this study demonstrates limited validity in the laboratory setting.

Keywords: Data correlation; Outcome measure; Pain measurement; Pressure; Validity; Osteopathic medicine; Algometry

1. Introduction

Measurement of the subjective pain experience can be performed using verbal or numerical rating scales and visual analogue scales,[1] and pain questionnaires such as the McGill Pain Questionnaire.[2] Pressure algometry is another method which has been used to measure and quantify an individual's pain experience.[3] The pressure algometer quantifies a patient's perceived pain by determining the pressure-pain threshold (PPT) – the point at which a subject perceives pain upon the application of a pressure or force stimulus.[3]

Normative data for pressure algometry over bony landmarks and muscles has been established by a number of authors.[4–8] Previous research has demonstrated that there is a lower average PPT over bone compared to muscle and the mean PPT has also been demonstrated to increase in the caudal direction.[6]

A number of methodological issues have been identified in the previously published research in relation to the use of pressure algometry for perceived pain measurement. These issues include the failure to indicate the rate of pressure application[8] and the importance of application of pressure at a constant rate,[9–11] using a verbal command from the patient to cease pressure

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application thus making the result dependent upon the reaction time of the examiner,[8,11] lack of appropriate training in the use of the device,[10] and also the sensitization or habituation due to the pressure previously applied when repeated measures are taken.[5] Hogeweg et al.[5] also suggest that 'alertness, consciousness and affection to the observer' may play a role in determining the pressure pain threshold.

Electronic or digital display algometers have been suggested to be more useful than their non-electronic counterparts as they allow the examiner to be guided as to he rate of pressure application and therefore control the rate of pressure application. This is via a built-in display on the electronic algometer that indicates a constant rate of application. This display can also be adjusted to display different rates of pressure application. The algometer also has a subject-operated push button that stops the algometer from further recordings, thus eliminating the reaction time of the examiner as an extraneous variable.[8,11–13]

Electronic algometers are considered to be more superior and produce better reliability due to the non-reliance on investigator reaction time[13] and ability to control the rate of pressure application.[14] However the validity of these readings has yet to be established against a known standard of force (pressure) measurement. Similarly, these improvements have not prevented the reporting of large standard deviation values with normative data in the published literature.

The aim of this study was to investigate the validity of a commonly utilised electronic pressure algometer against measurements recorded simultaneously on an AMTI force plate (Advanced Medical Technologies Inc., USA).

2. Materials and methods

2.1. Pressure algometer

The pressure algometer (Fig. 1) used in this study was a commercially available hand held electronic pressure algometer (Somedic Algometer Type II, Sweden). The electronic display provides a pressure reading in kilopascals (kPa) and also displays the rate of applied pressure in a small LED window. The operator is able to maintain a constant application rate by keeping the '+' sign in the middle of the LED window. The rate of applied pressure can be set between 10 kPa/s and 50 kPa/s in increments of 10 kPa/s.

As for the standard application of the algometer on a human subject, a 1 cm^2 rubber tip was attached to the probe. The algometer had a lead attached connected to a stop button, which when pressed, instantly froze the pressure reading. Pressing the button also produced an audible sound to indicate that a measurement had been taken. The pressure algometer was calibrated prior to each data collection series. The calibration process was undertaken according to the manufacturer's instructions prior to each change of rate of pressure application and before each trial began. The manufacturers state the accuracy of the pressure algometer is ±3% of the displayed value.

Fig. 1. The pressure algometer.

2.2. Force plate

An AMTI force plate (Advanced Medical Technologies Inc., USA) was used to simultaneously sample force readings as the pressure algometer was applied perpendicular to its surface. A sampling rate of 500 Hz was used with no filters. AMLAB software (AMLAB Technologies, NSW, Australia) was used to record and extract the maximum vertical force values from these trials. The calibration process was undertaken according to the manufacturer's instructions prior to each trial. The manufacturers state the sensitivity of the force plate is 0.04 $\mu V/(V \times N)$.

2.3. Training procedure

Prior to the two trials, investigator 1 (BV) undertook three training sessions (totaling five hours) in the use of the pressure algometer. During these sessions, the investigator practiced keeping the '+' sign in the middle of the pressure scale indicated on the algometer (Fig. 2). This technique was practiced for all of the pressure application rates.

Use of the AMTI force plate and the AMLAB software does not require any special training as the only input from an examiner is to start the computer program that records the data obtained from the plate. The investigator operating the AMLAB software was an experienced biomechanist (PM).